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Chemical, Microbial and Sensory Properties of Candied-Pineapple and Cherry Cakes

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ABSTRACT

The chemical, sensory and microbial qualities of candied-pineapple and cherry cakes were investigated. Both cake samples were also analyzed for chemical composition and microbial load before, during and after 56 days storage at room temperature. There were significant differences ($p < 0.05$) in the physico-chemical composition of the cherry cake and candied pineapple cake except for protein values of 9.00% and 8.63% respectively and magnesium content with values of 0.23% and 0.27% respectively. Sensory evaluation results showed significant differences ($p < 0.05$) between the two samples with the exception of colour (7.84) for both samples and texture (7.84 and 7.80) for cherry and candied pineapple cakes, respectively. In terms of general acceptability, the candied-pineapple cake was most preferred (8.52). The microbial loads (bacterial and fungal) of the candied pineapple cake were lower than the cherry cake throughout the duration of the 56 days storage at room temperature. The highest bacterial load was recorded after the 28th day (148.0×10^5 cfu/g) and (194.30×10^5 cfu/g) for candied pineapple and cherry cakes respectively. The fungal load was also highest at 28th day of storage (14.33×10^3 cfu/g) and (12.67×10^3 cfu/g) for candied pineapple and cherry cakes respectively. The total viable counts (TVC) were within acceptable limits for human consumption. Therefore, candied-pineapple can readily substitute cherry in fruit cake making in Nigeria.

Keywords: candied-pineapple cake, cherry cake, chemical, sensory, microbial composition.

Introduction

Cake is a form of food that is usually sweet and is a baked product (Hermes, 1999). Cake is a mixture of flour, a sweetening agent, sugar, a binding agent generally egg, (though gluten or starch is often used by vegetarians and lacto-vegetarians), fats (usually butter, shortening or margarine, although a fruit puree such as apple sauce is sometimes substituted to avoid using fat, a liquid (milk, water or fruit puree), flavours and some forms of leavening agents such as yeast or baking powder, although many cakes lack these ingredients and instead rely on air bubbles in the dough to expand and cause the cake to rise (Stradley, 2004).

Among the various classifications of cakes is the fruit cake. The fruit cake quality is largely determined by the type of fruits and nuts it contains, these can include a whole range or be limited to selected fruits or nuts depending on the recipe, taste or market. The fruit can include lemon and orange peel, raisin, dates, apricots, citron (the preserve rind of citron fruit), carrots, figs and cherries. These fruits are all preserved, dried, candied or glazed so that much of their natural moisture is removed to keep them longer (Cosman, 1976; Siestema, 2002). Cherry is a bright red coloured fruit which can be eaten fresh. These fruits are found in yellow colour as well. They can be eaten raw and may be used for flavouring foods and as ingredients in fruit cakes and wine preparations (Yu *et al.*, 1999). Cherry is a good source of potassium, manganese, vitamin A, C, B complex, magnesium, copper and is an

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excellent source of flavonoids (USDA, 2008). It is common to use the candied cherries when baking, as a sweetener, nutrient booster and moisturizers for cakes and cookies (www.ehow.com march, 2009).

Pineapple (*Ananas comosus*) is a common name for an edible tropical plant and its fruit. It is a juicy sweet fruit which is nutritious and can be eaten raw or used in cooking. It is rich in a variety of minerals and vitamins with numerous health benefits, United States Nutrient Database (2011), pineapples have diuretic, anti-cancer and anti-inflammatory properties and is good for protein digestion due to the presence of certain enzymes (Monzon *et al.*, 1995).

Cake preparation is one of the expensive baking operations in the food industry due to the expensive nature and non-availability of its ingredients which are mostly imported, especially when bans are placed on some of the imported ingredients. Cherries, one of the vital ingredients in a rich good-quality fruit cake is rarely available, extremely expensive and cannot be afforded by many bakers in the baking and confectionery industry in Nigeria. There is also a dearth of information on the use of candied-pineapple in fruit cake production. Therefore, the aim of the present study was to substitute cherries with candied-pineapple and determine the chemical and sensory qualities of the cake as well as its storage stability.

Materials and Methods

The fresh pineapple sample (*Natal queen cultivar*) was procured from Michael Okpara University of Agriculture, Umudike, Abia State farm centre. The cherry and other ingredients used for baking the cake were procured from Umuahia main market. The analysis was carried out in the central laboratory unit of the National Root Crops Research Institute, Umudike, Abia State.

Sample preparation

Candied pineapple

One fresh pineapple (*Natal queen cultivar*) obtained from the school farm was cleaned and peeled. The size was reduced into cubes and then syrupped and coloured with red food colouring by boiling until all the syrup was absorbed by the pineapple to form candied pineapple.

Pineapple fruit cake

The creaming method was used to prepare the batter for the fruit cakes. Five hundred grams (500 g) of sugar was creamed with one kilogram (1 kg) of margarine using the cake mixer until the batter became light and fluffy (Wilton Cakes, 2009). In another bowl, eight (8) large eggs were whisked till they became foamy and firm then, two kilograms (2 kg) of wheat flour were sieved together with four (4) teaspoons of baking powder and half ($^1/_2$) teaspoon of nutmeg. The whisked eggs and flour mixes were folded into the batter (sugar and margarine), then the candied pineapple was incorporated into the cake mix and turned into a greased pan and baked in an oven at 150^{o}C for 1h. The same procedure and measurements were used for the cherry fruit cake.

Chemical analysis

The proximate composition (moisture, fat, protein, crude fiber, carbohydrate) of the cherry and candied-pineapple fruit cakes were determined using the method of AOAC (1990). The mineral determination was carried out by measuring 3 g of the cake samples and burning them to ashes (as in ash determination) thereby removing all the organic materials, leaving the inorganic ash. The resulting ashes were dissolved in 5 ml of 0.1M. HCl solution and then diluted to 100 ml in volumetric flask. These extracts were used in specific analysis for the determination of calcium and magnesium (AOAC, 1990).

Determination of calcium and magnesium

The versante EDTA titrimetric method was employed, 20 ml portion of extract was dispensed into conical flask and treated with drops of the marking agent (hydroxylamine hydrochloride, sodium cyanide and sodium potassium ferrocyanide) (AOAC, 1990). The flask was shaken and the mixture dissolved, then 20 ml of ammonia buffer

was added to it to raise the pH to 10 (a point at which both calcium and magnesium form complexes with EDTA). The mixture was titrated against 0.02N EDTA solution using erichrome black as an indicator. A reagent blank was also titrated and titration in each case was done from deep red to a permanent blue end point. The titration value represents both Ca^{2+} and Mg^{2+} in the test sample. A repeat titration was done to determine Ca^{2+} alone in the test sample using the same method. However, 10% NaOH was used in place of ammonia buffer and sole chrome dark blue indicator in place of erichrome black T.

From the titre value obtained, the Ca^{2+} and Mg^{2+} contents were calculated as shown below:

Ca (mg)/Mg (mg) = 100/W X T – B (N X Ca/ Mg)

Where W = weight of sample
T = titre value of sample
B = black titre value
Ca = calcium equivalence
N = normality of titrant (0.02N EDTA).

Microbial load determination

The method of the International Commission on Microbiological Specification of Foods (ICMSF, 2009) was used. A unit weight of a homogenate sample of each fruit cake was aseptically mixed with 9ml of sterile distilled water in a test tube. The mixture was diluted serially to the sixth diluents (10^6). Then, 1ml inocula was taken from the 2nd (10^2) and the 4th (10^4) diluents and used for the culture of fungi and bacteria respectively. In each case, the inoculum was aseptically placed on the surface of an appropriate sterile medium and with the aid of a flamed glass hockey; it was spread over the surface of the medium. The inoculated plates for fungal counts were incubated at room temperature (28 – 32°C) for 2 – 5 days while those for bacterial culture plates were incubated at room temperature (37°C) for 24 – 48 hrs. The incubated plates were observed daily for growth on establishment of growth and the number of colonies on each plate was counted with the aid of a colony counter. The number of colonies on each plate was observed as the number of colony forming unit (cfu) and the total viable count was calculated using the formula below:

TVC (cfu/g) 1/v X N
Where TVC = Total viable count
v = Volume of innoculum
N = Number of colonies counted

Sensory evaluation of cherry and candied-pineapple fruit cake

Sensory evaluation of the cake samples were conducted within 24h of production in the food processing laboratory of department of Food Science and Technology, Michael Okpara University of Agriculture, Umudike, using a 25-member semi-trained panelists who are familiar with cakes. The 9-point hedonic scale was used where 1 and 9 represented dislike extremely and like extremely respectively.

Statistical analysis

Results were expressed as means + standard deviation. Statistical analysis was carried out using SPSS Version 15.0 software and the significant differences were established using Duncan's Multiple Range Test.

Results and Discussion

The proximate composition of cherry cake (see plate 1) and candied-pineapple cake (see plate 2) is shown in Table 1. There were no significant differences ($p > 0.05$) in the protein, ash, and magnesium contents of the cherry cake and pineapple candy cake which ranged from 9.00 – 8.63%, 3.03 – 1.15% and 0.27 – 0.23 mg/100 g respectively. Significant differences ($p < 0.05$) were observed in the moisture content of the cherry cake (35.00%) and candied-pineapple cake (29.22%), fat content (48.03%) and (50.01%); calcium (61.5 mg/100 g) and 106.9 mg/100 g) and the carbohydrates (4.91%) and (10.99%) respectively. Raw cherries and pineapple had been reported to contain protein values of 0.77 g and 0.54 g respectively.

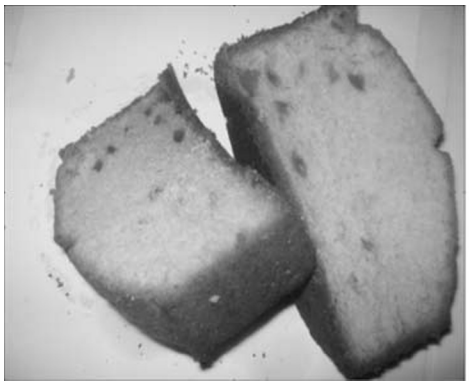

Plate 1: Cherry fruit cake

Plate 2: Candied-Pineapple fruit cake

Table 1: The chemical composition of cherry cake and candied-pineapple cake

Samples	% Protein	% Moisture	% Fat	% Ash	% Cho	mg/100 g Magnesium	mg/100 g Calcium
Cherry Cake	9.00[a]	35.0[a]	48.03[b]	3.03[a]	4.91[b]	0.23[a]	61.5[b]
	+0.22	+0.92	+1.18	+0.08	+0.02	+0.06	+ 4.63
Pineapple Cake	8.63[a]	29.22[b]	50.01[a]	11.5[b]	10.99[a]	0.27[a]	106.9[a]
	+0.21	+0.02	+0.03	+0.03	+0.04	+0.06	+2.31
LSD	0.43	0.77	0.21	0.10	0.07	0.11	7.55

Values represent mean ± standard deviation of triplicate determinations

Mean with the same superscript on the same column are not significantly different ($p > 0.05$). LSD represents the least significant difference among the means.

In terms of sensory attributes, there were significant differences ($p < 0.05$) between the cherry cake and candied-pineapple cake except for appearance (7.84) respectively and texture (7.84) and (7.80) respectively as shown in Table 2. The similarity appearance between the two samples could be because of the food colour additive used for the pineapple candy which was cherry red in colour. The taste of candied-pineapple cake scored higher (8.44) than the cherry cake (7.56) which made it more generally acceptable. This could be attributable to impact of pineapple flavour on the fruit cake.

Table 2: Sensory evaluation of cherry and candied-pineapple cake samples

Cake Samples	Taste	Colour	Texture	Flavour	General Acceptability
Cherry Cake	7.56[b] ± 0.92	7.84[a] ± 0.80	7.84[a] ± 1.21	7.84[b] ± 0.85	7.60[b] ± 1.15
Pineapple Cake	8.44[a] ± 0.58	7.84[a] ± 0.80	7.80[a] ± 1.00	8.21[a] ± 0.88	8.52[a] ± 0.65

Values represent means of triplicate determinations ± standard deviation.

The nutrient composition of the cake stored for 56 days at room temperature is shown in table 3. The protein values were 9.50% and 9.34% for cherry and candied-pineapple cake respectively, though no significant difference ($p > 0.05$) existed among them. Moisture contents increased to 38.17% for cherry cake and 30.97% for candied-pineapple cake. These increase in protein and moisture values as the length of storage time for both cake samples increased could be due to the fermentation process and the microbial (especially bacterial) growth on the cake samples as well as the absorption of moisture from the environment as the cake samples were kept under room temperature. However, there were significant ($p < 0.05$) decreases in the ash and fat contents of the cherry cake (2.91%) and (38.98%) respectively while the pineapple candy cake had (1.05%) and (46.97%) respectively as the storage time increased. The minerals (calcium and magnesium) also decreased with length of storage. This was inevitably evident of the increased microbial presence in the cake samples resulting to nutrient depletion.

Table 3: Mean values of some nutrient composition of cherry and candied-pineapple cake samples stored for 56 days at room temperature

Samples	% Protein	% Moisture	% Fat	% Ash	% Cho	Mg/100g Magnesium	Mg/100g Calcium
Cherry Cake	9.50^a	38.17^a	38.98^b	2.91^a	9.02^b	0.17^a	49.43^b
	+0.55	+0.04	+0.47	+0.08	+0.02	+0.06	+2.31
Pineapple Cake	9.34^a	30.97^b	46.97^a	1.05^b	11.54^a	0.23^a	97.53^a
	+018	+0.09	+0.17	+0.90	+0.04	+0.06	+2.31
LSD	0.71	0.41	0.58	0.14	0.06	0.12	6.53

Value represent mean $\pm$ standard deviation of triplicate determinations mean with the different superscript on the same column are significantly different ($p < 0.05$). LSD represents the least significant difference among the means

Table 4 indicates the bacterial load of the cake samples during 56 days of storage at room temperature. Significant differences ($p < 0.05$) were observed in the bacterial load of the cake samples except in day 0 (11.67 x 105cfu/g) for cherry cake and (10.67 x 10^5 cfu/g) for candied-pineapple cake. There were also significant differences ($p < 0.05$) between the bacterial load of (17.33 x 10^5cfu/g) cherry cake and pineapple candy cake (15.33 x 10^5 cfu/g). However, the bacterial loads of the cake samples were observed to be on the increase from day 0 to day 28 (11.67 x 10^5cfu/g – 194.30 x 10^5 cfu/g) respectively for cherry cake and (10.67 x 10^5cfu/g – 148.0 x 10^5 cfu/g) respectively for pineapple candy cake and then started declining from days 42 to days 56 (161.0 x 10^5cfu/g – 121.10 x 10^5cfu/g) for cherry cake and (126.30 x 10^5cfu/g -102.0 x 10^5cfu/g) for pineapple candy cake.

Table 4: Mean bacterial load for cherry and candied-pineapple cake samples

Sample cfu/g(10^5)/days	0	1	14	28	42	56
Cherry cake	11.67[a]	17.53[a]	115.71[a]	194.30[b]	161.0[a]	121.0[a]
	+ 2.31	+ 1.15	+7.09	+6.51	+7.00	+3.00
Pineapple cake	10.67[a]	15.33[a]	90.30[b]	148.0[b]	126.30[b]	102.0[b]
	+ 0.58	+1.53	+7.02	+8.72	+ 8.39	+8.72
LSD	3.05	2.58	17.44	14.25	12.81	12.26

Values represent mean ± standard deviation of triplicate determinations

Mean with the different superscript on the same column are significantly different ($p < 0.05$). LSD represents the least significant difference among the means.

Generally, the bacterial count of cherry cake was higher than that of the candied-pineapple cake which might be adduced to the length of storage time before it was used or the handling while retailing. The total viable counts (TVC) for bacteria which were observed to increase from day 0 to days 14, reached their peaks on days 28 and dropped to days 56 for both cakes were in agreement with the nature or growth pattern of bacteria (Ezeama, 2007). The microorganisms present in both cakes were a direct reflection of the sanitary quality of the source of materials, processing and storage of the samples (Beuchat, 1996; Ray and Bhunia, 2007). The values obtained for both cakes were within the acceptable International Commission on Microbiological Specification (ICMSF) limits and recommendation for products of this nature (10^5 cfu/g) in good manufactured practice (ICMSF, 2009). The fungal loads of the cake samples after 56 days of storage under room temperature were shown in Table 5. Results showed that there were no significant differences ($p > 0.05$) among the fungal loads of both samples. On day 0, the fungal load was 2.67 x 10^3 cfu/g for cherry cake and 2.33 x 10^5 cfu/g for candied-pineapple cake.

Table 5: Mean fungal loads for cherry and candied-pineapple cake samples

Sample cfu/g(10^5)/days	0	1	14	28	42	56
Cherry cake	2. 67[a] ± 0.58	3. 33[a] ± 0.58	7.33[a] ± 2.08	12.67[a] ± 1.53	10.67[a] ± 1.15	8.67[a] ± 0.58
Pineapple cake	2.33[a] ± 0.58	2.67[a] ± 0.58	6.33[a] ± 0.58	14.33[a] ± 2.08	10.00[a] ± 1.00	8.67[a] ± 1.73
LSD	1.15	1.15	2.58	3.19	2.21	2.90

Values represent means ± standard d of triplicate determination

Means with the same superscript in the same column are not significantly different ($p > 0.05$). LSD represents the least significant difference among the means.

The values gradually increased to the 28th day where they reached their peak (12.67 x 103cfu/g) and (14.33 x 10^5 cfu/g) respectively, then they started declining to the 56th day (8.67 x 10^3 cfu/g) respectively. The fungal load values obtained for cherry and cherry and candied-pineapple cakes were within acceptable limits for products of this nature as recommended by ICMSF for good manufacturing practice (10^3 cfu/g) (ICMSF, 2009).

Most fresh baked products have only a few days shelf life at ambient temperature. Microbial growth is the major cause of losses in the bakery industry. The microbial spoilage in cakes is caused by fungal growth, which mainly takes place on the surface (Rodriguez *et al.* (2007).

Conclusion

There were no significant ($p > 0.05$) differences between cherry cake and candied-pineapple cake in terms of protein and magnesium values. The sensory scores for candied pineapple cake was higher than that of cherry cake especially in terms of general acceptability and its bacterial and fungal loads were lower than that of cherry cake after 56 days of storage at room temperature. Therefore, it could be inferred that candied-pineapple can comfortably substitute cherry in the baking of fruit cakes, thereby promoting the use of our indigenous and available fruit (pineapple). Furthermore, candied-pineapple cakes kept under room temperature for a period of 3 weeks can still be safe for consumption.

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